



Decline Curves

Joint House Resources and Energy Committees

23 April 2012

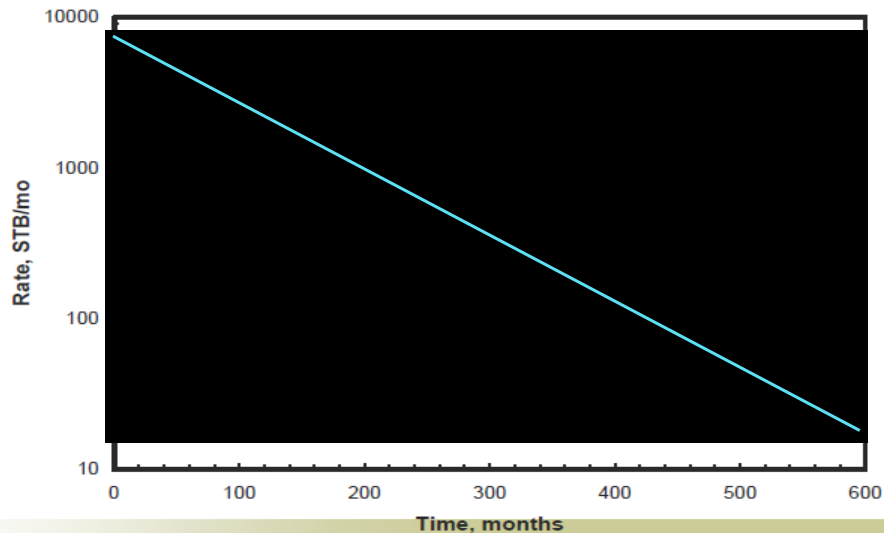
William C. Barron

Division of Oil and Gas





Decline Curve Shapes: Semilog Rate-Time



- Exponential $b=0$, $q_t = q_i \exp(-D_i t)$
- Hyperbolic decline $b > 1$: $q_t = q_i / (1 + b D_i t)^{(-1/b)}$
- Harmonic Decline where $b=1$, $q_t = q_i / (1 + D_i t)$

Where: t = time of interest, q_t = rate at time t , q_i = initial rate, D_i is decline rate at time 0 ($1/\text{time}$), b = Arps' decline constant describing curvature of semi-log rate vs. time





Items Affecting Production

Adding Production

- Well Drilling
- Well Maintenance
- Enhanced Oil Recovery
- New Facilities, Infrastructure, Debottlenecking
- New Technology

Decreasing Production

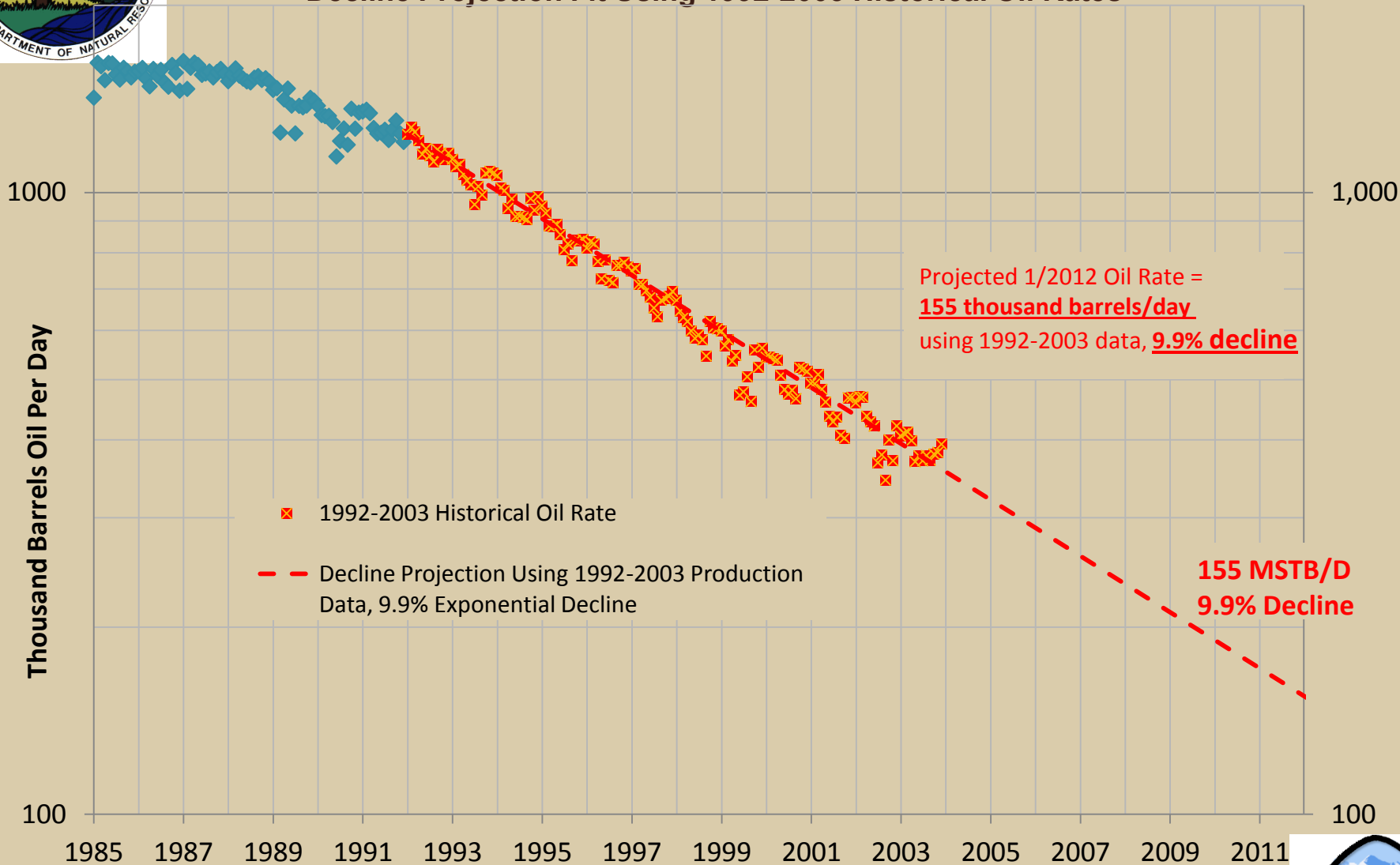
- Aging facilities and infrastructure
- Gas and Water Handling
- Well Failures
- Decreasing new well rate with time
- Costs





PBU Initial Participating Area

Decline Projection Fit Using 1992-2003 Historical Oil Rates



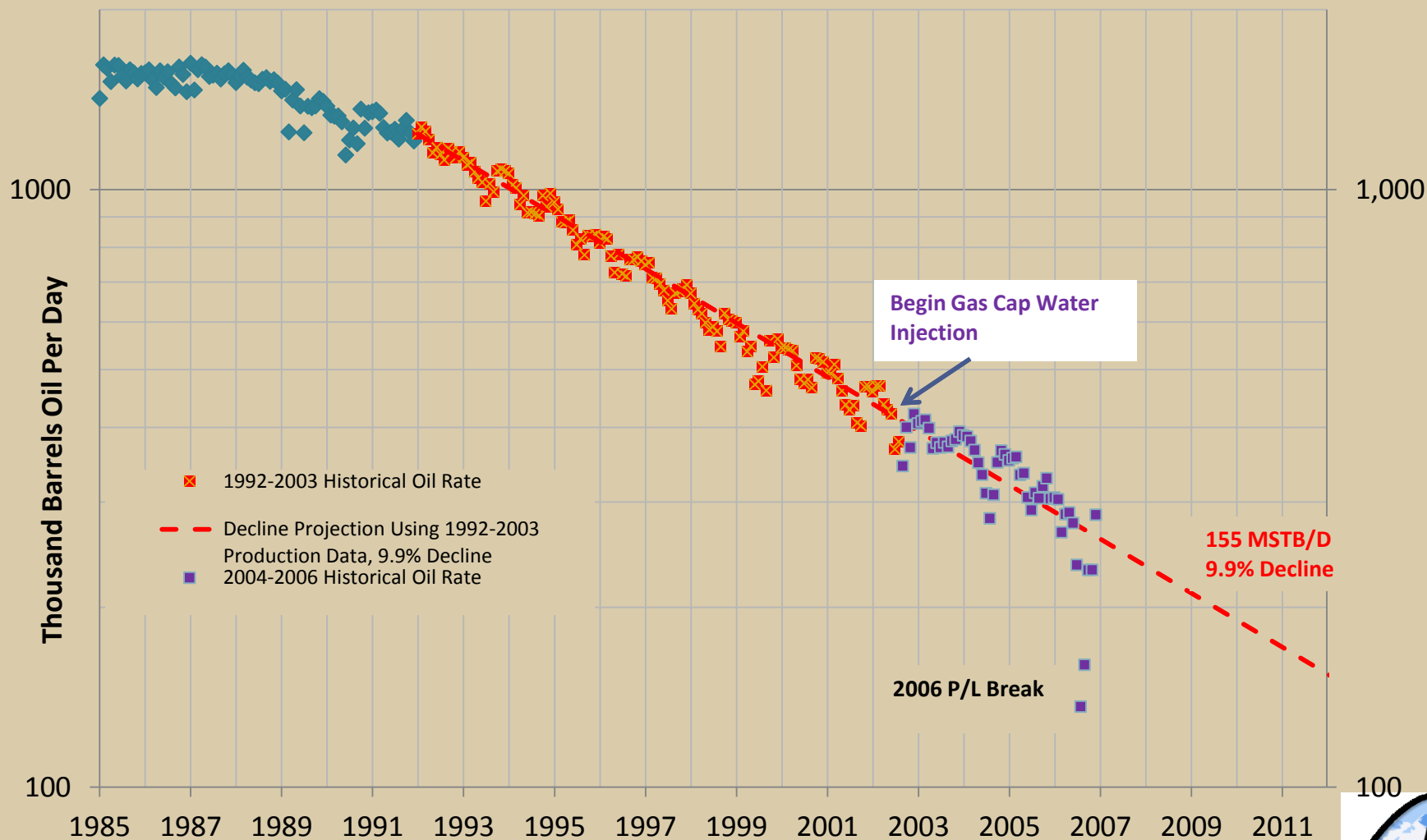


PBU Initial Participating Area

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Decline Projection Fit Using 1992-2003 Historical Oil Rates

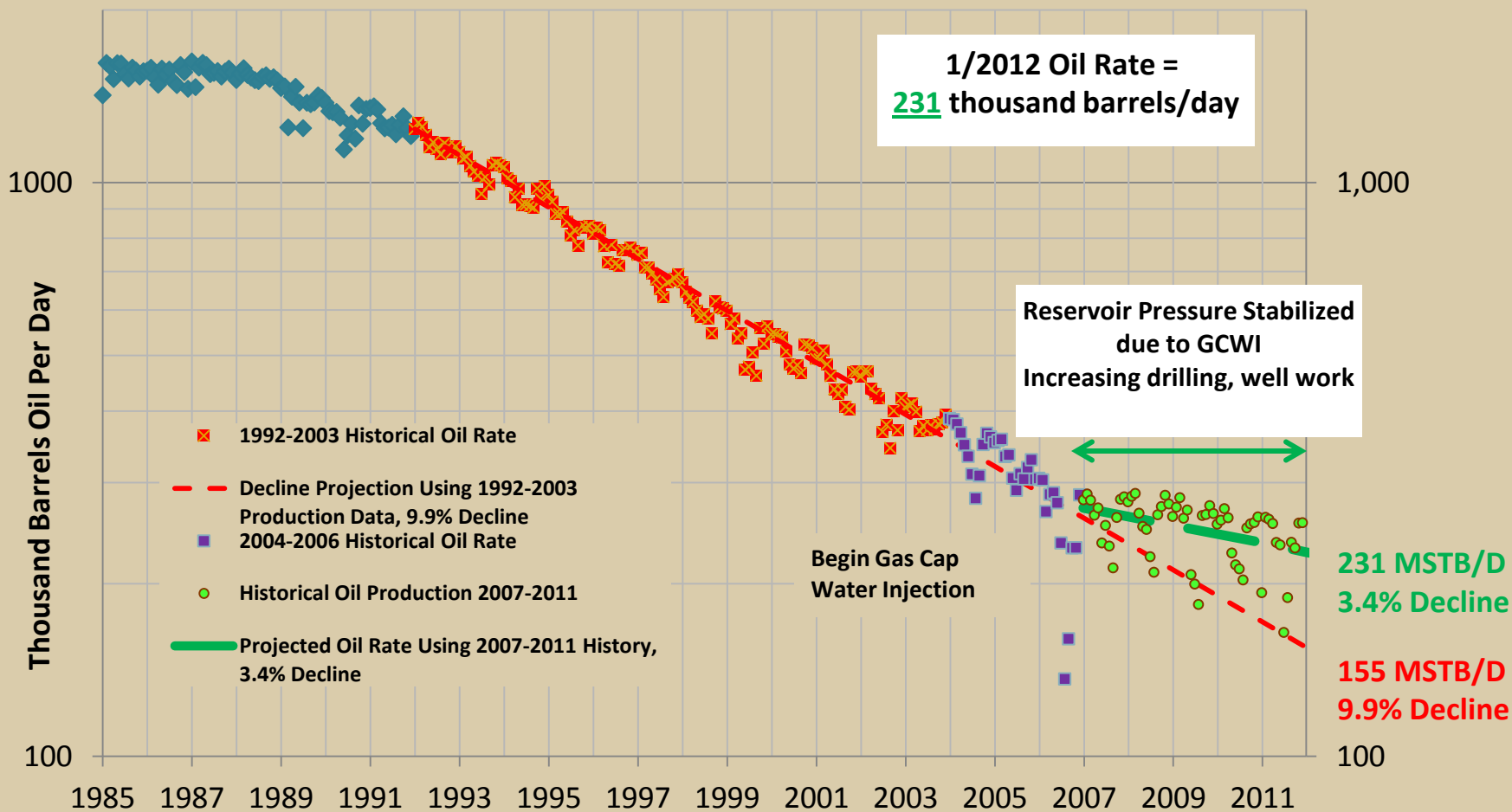
Gas Cap Water Injection Begins 2002





PBU Initial Participating Area

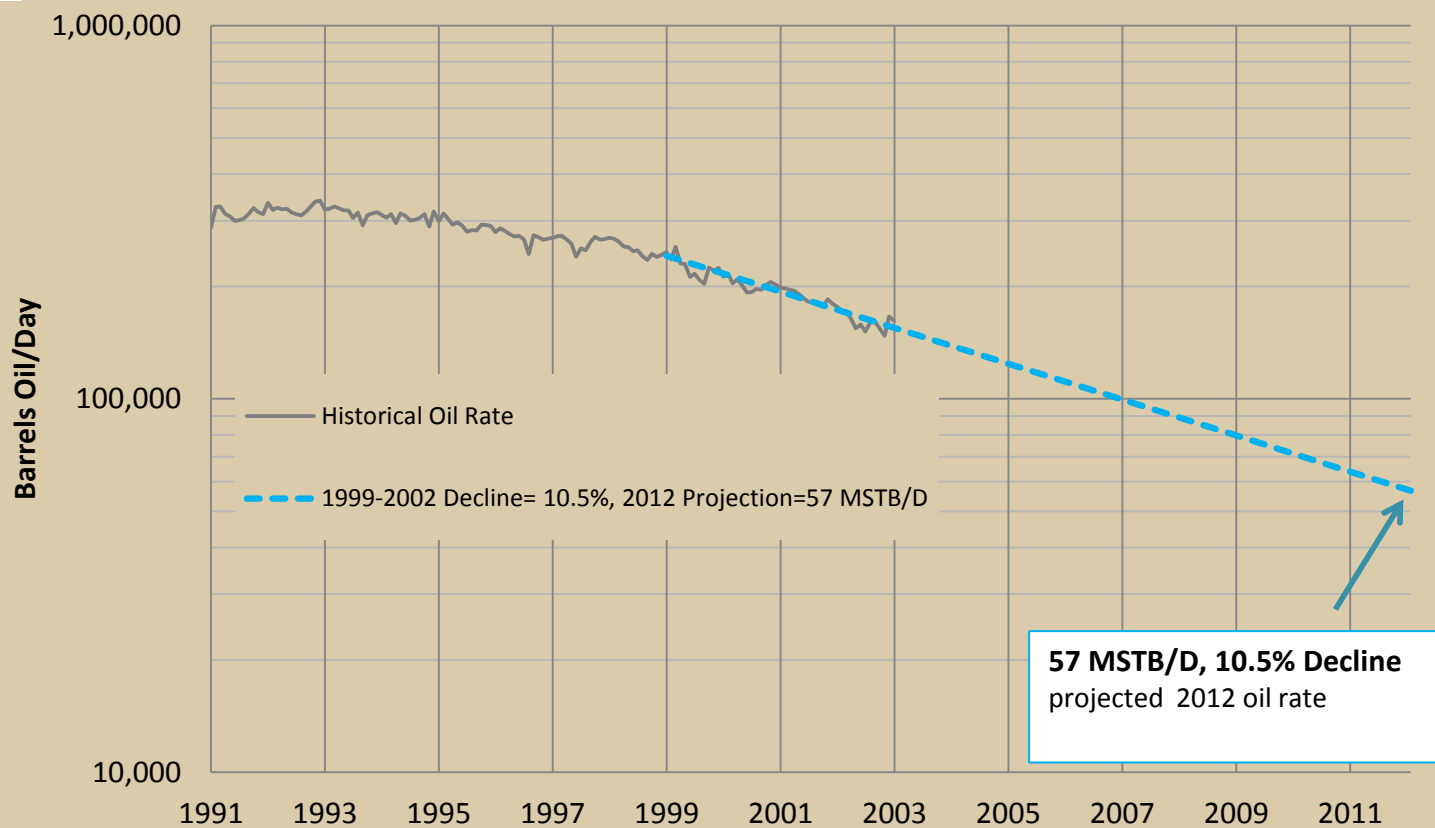
Decline Projection Using 2007-2011 Data
Effect of Gas Cap Water Injection, Drilling, Well Work
Oil Rate increase of +/- 75 thousand barrels/day





Kuparuk River Unit - Kuparuk Participating Area

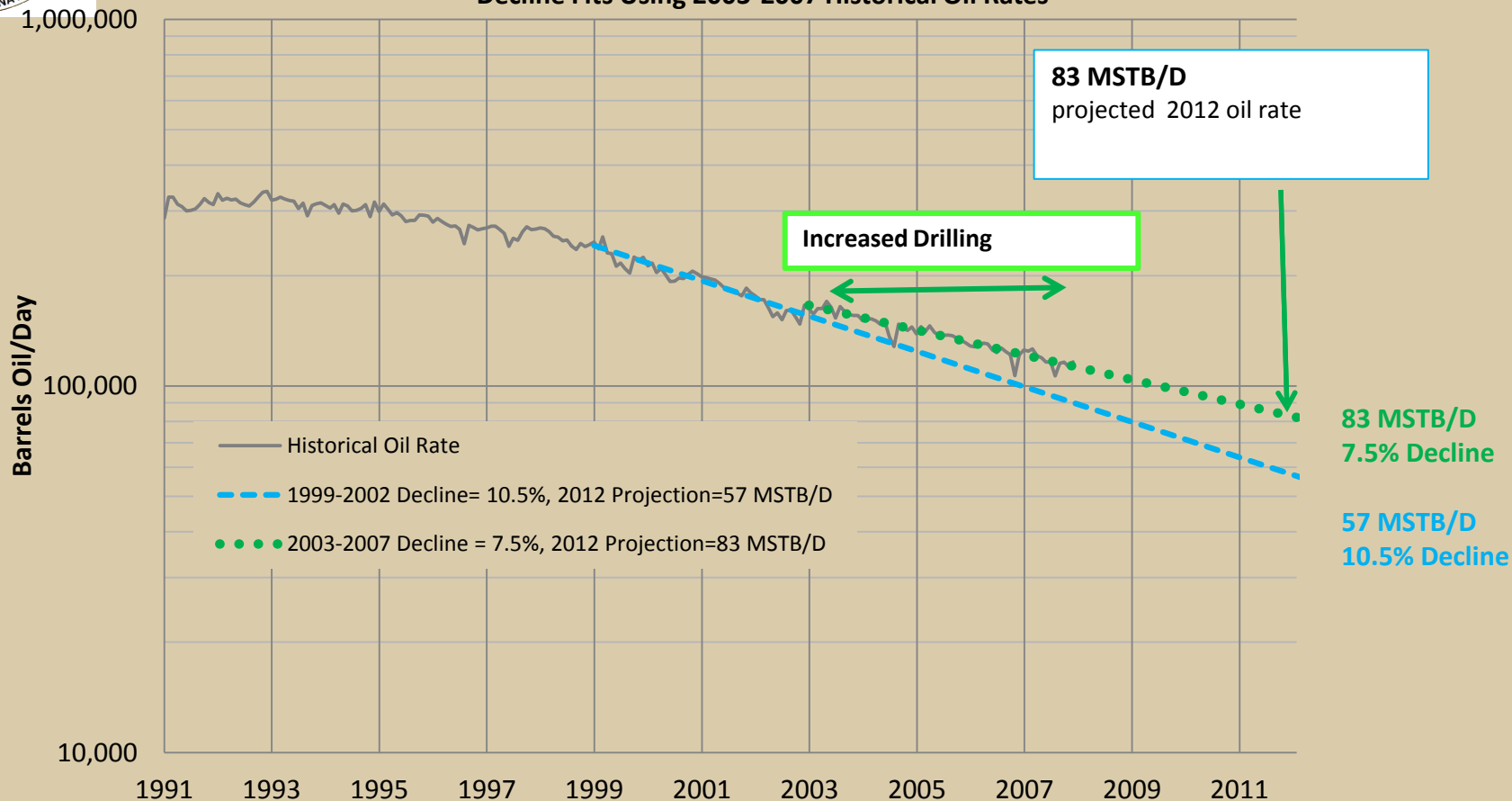
Decline Fits Using 1999-2002 Historical Oil Rates





Kuparuk River Unit - Kuparuk Participating Area

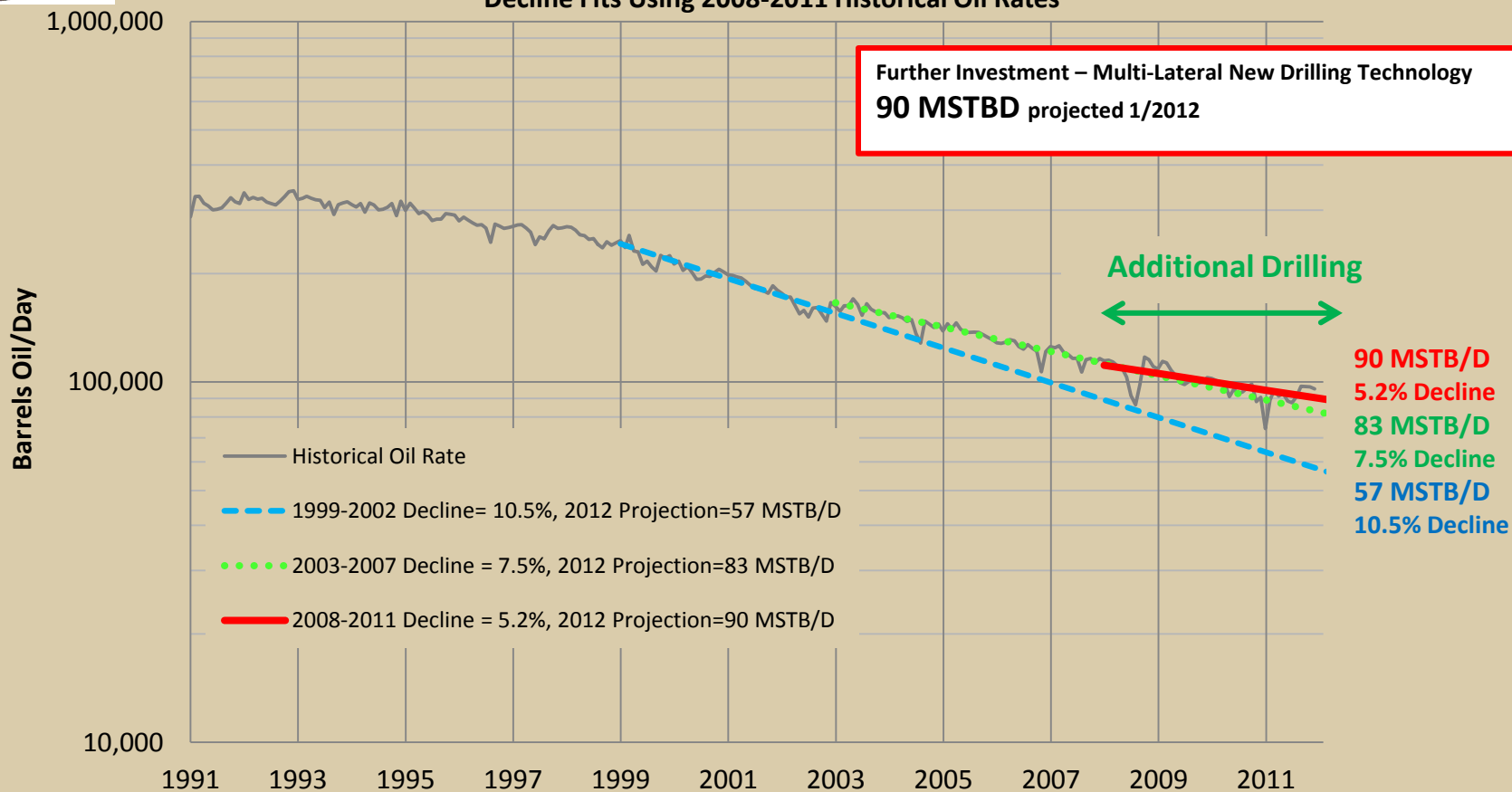
Decline Fits Using 2003-2007 Historical Oil Rates





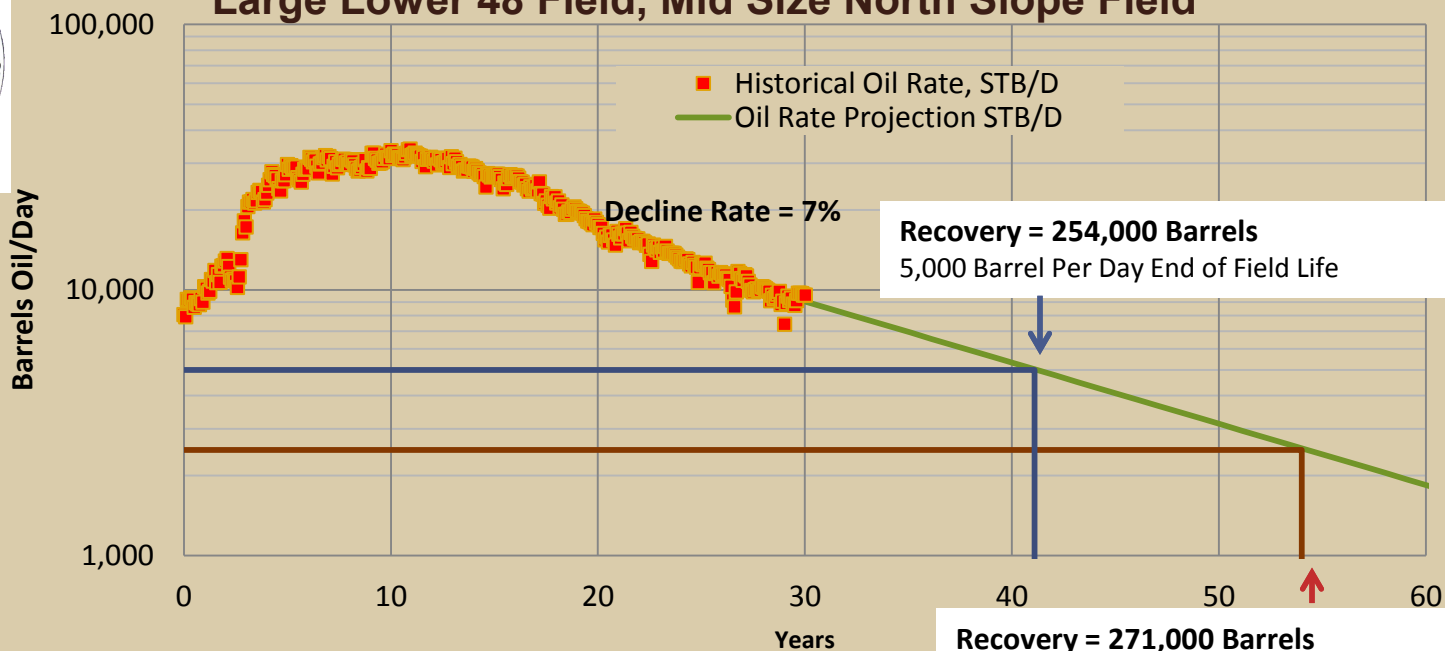
Kuparuk River Unit - Kuparuk Participating Area

Decline Fits Using 2008-2011 Historical Oil Rates

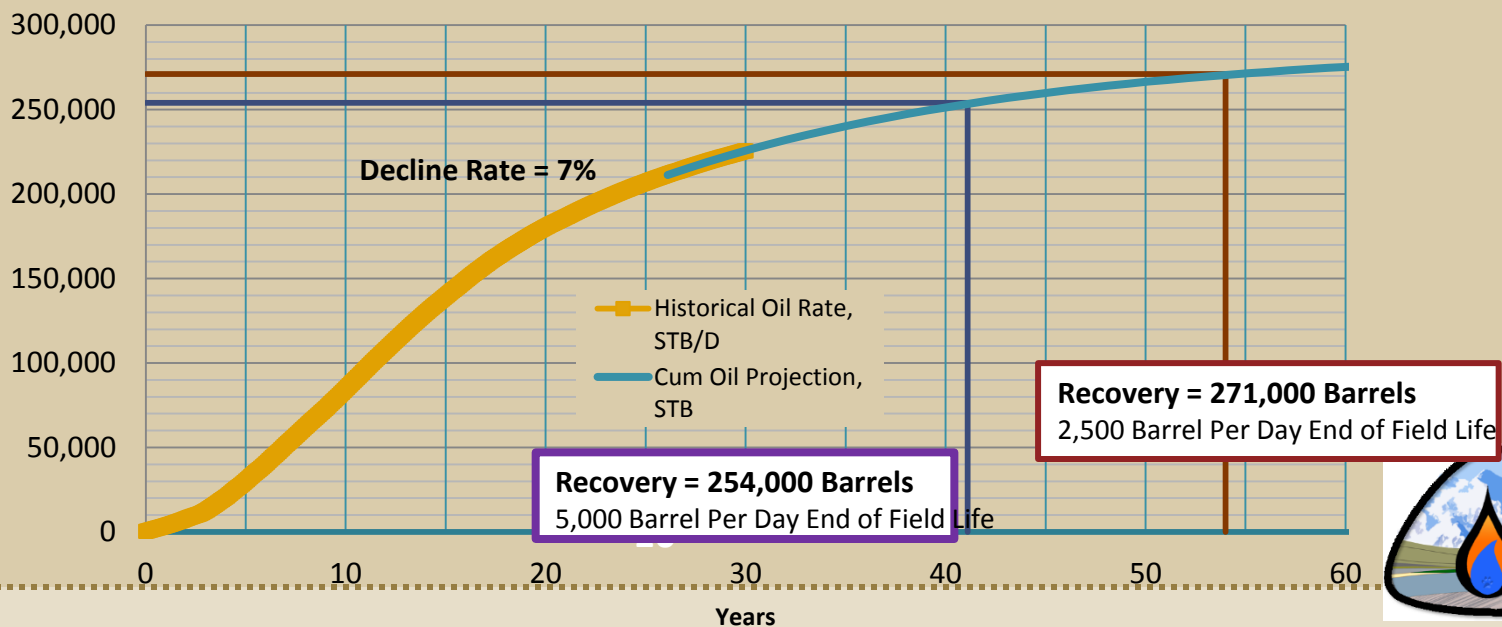


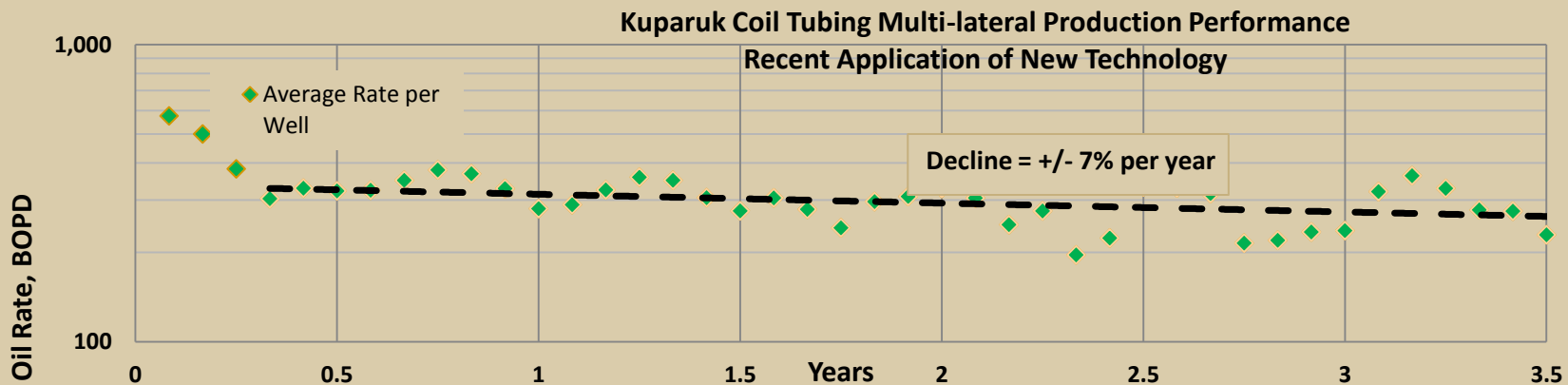
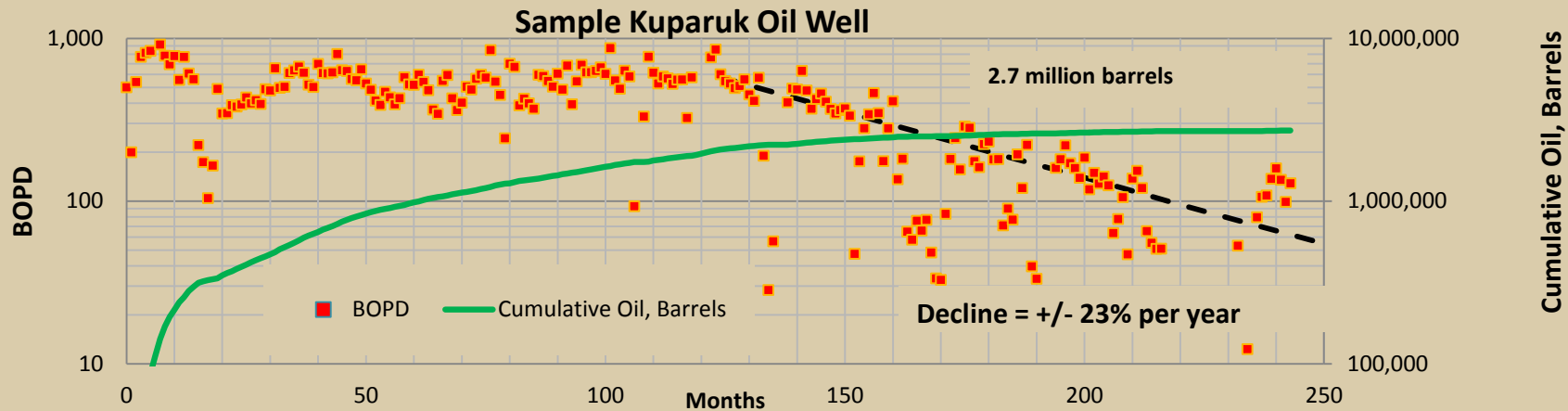
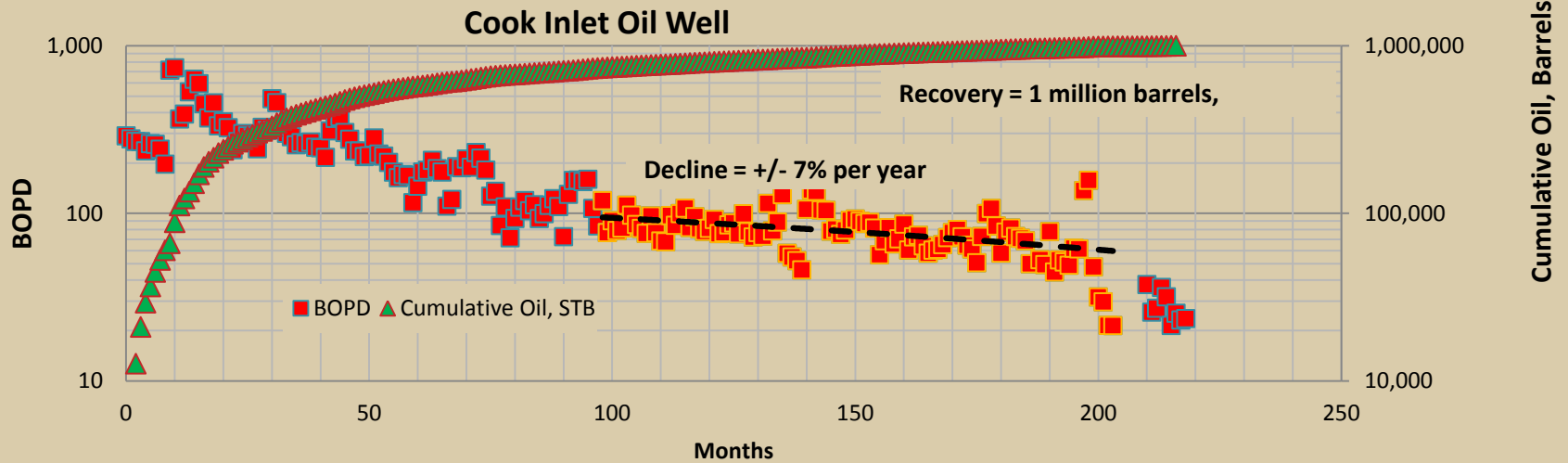


Large Lower 48 Field, Mid Size North Slope Field



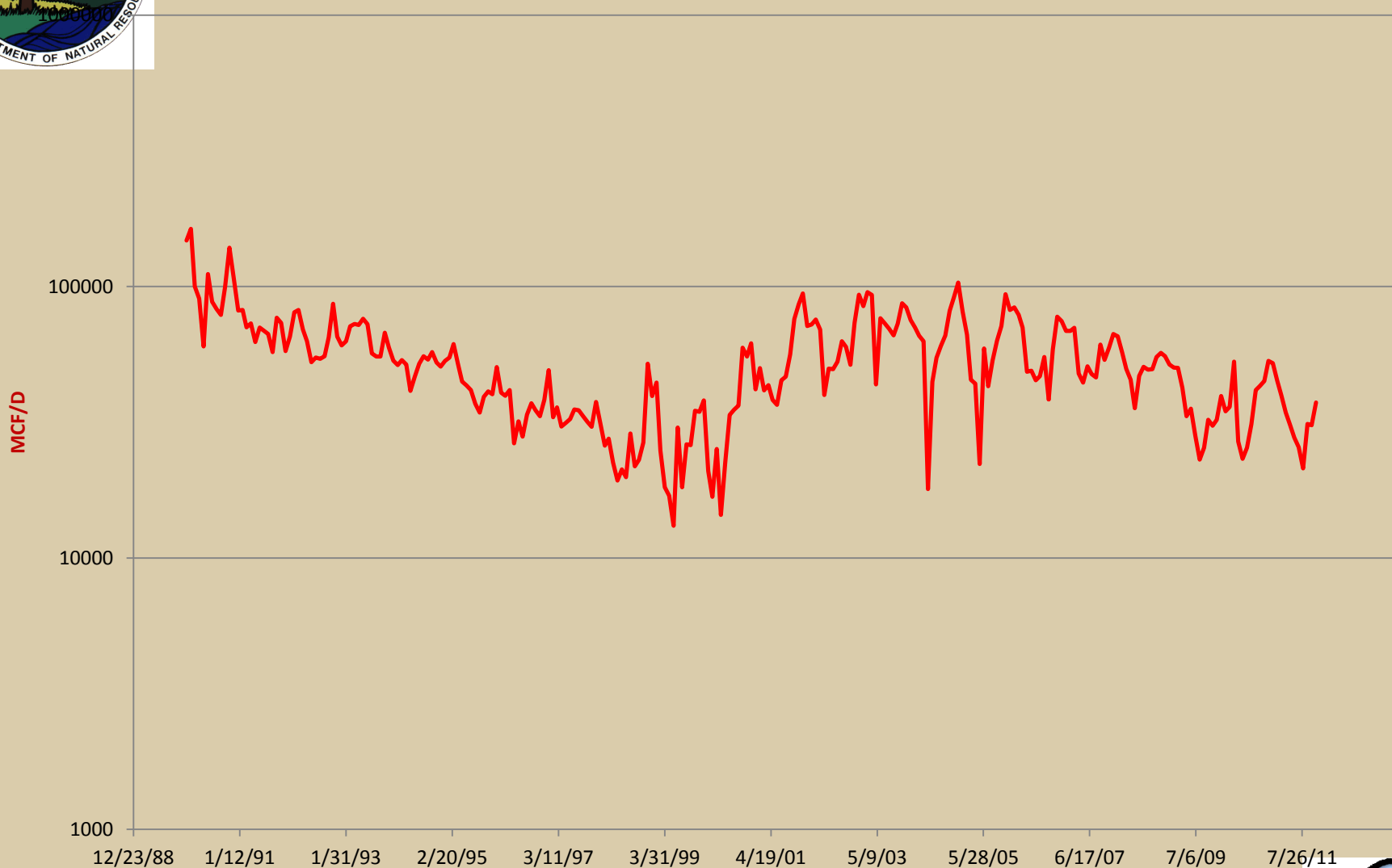
Cumulative Oil, Barrels



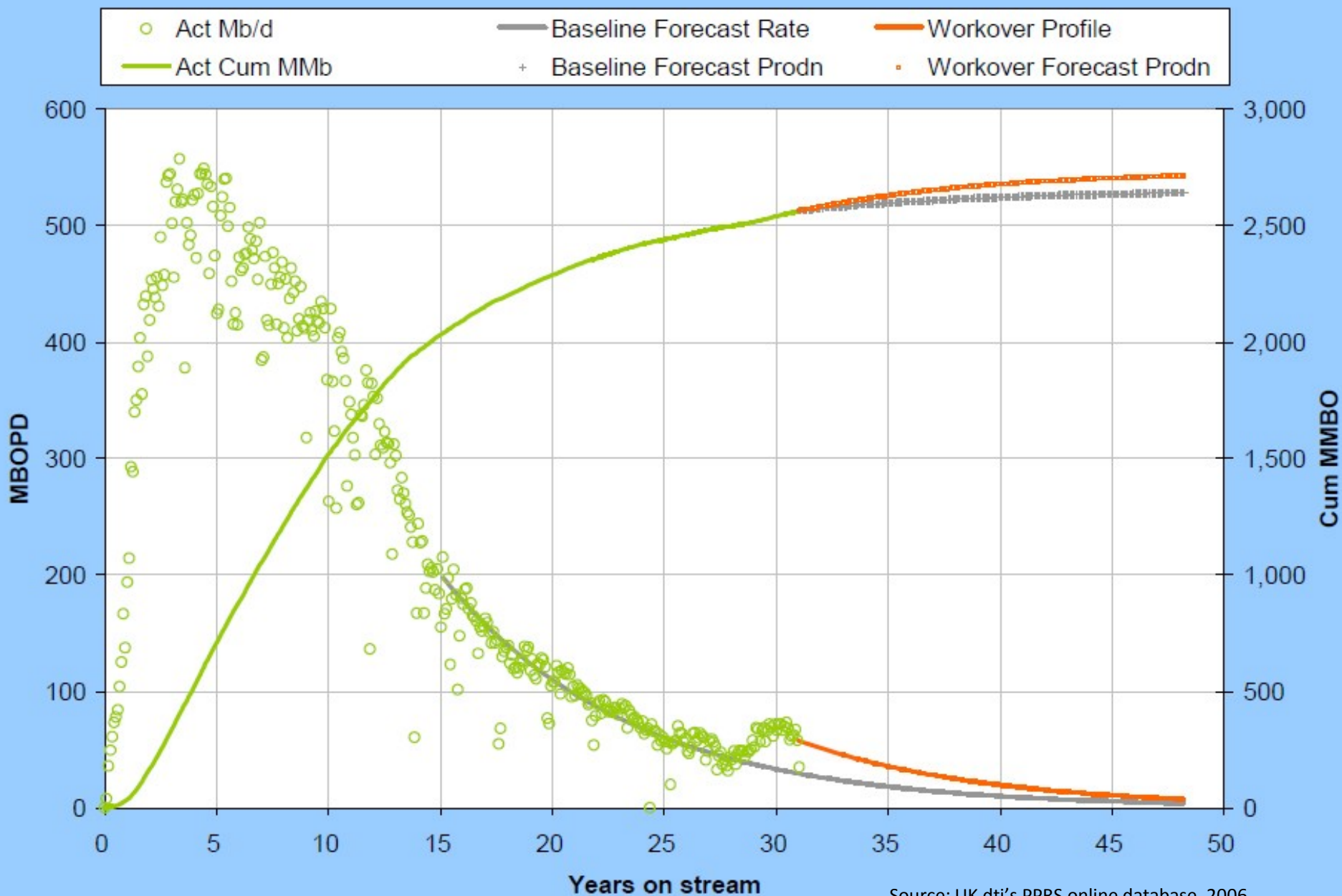




Kenai Gas Field Daily Gas Production in mcf/d



Forties Field, North Sea, production





What will it take to reach the goal?

- Collaborative and competitive environment
- Minimize all barriers
- Access all fields and all types of oil

